PB 207 144

ECONOMIC IMPACT OF ANTICIPATED PAPER INDUSTRY POLLUTION – ABATEMENT COSTS

PART I: EXECUTIVE SUMMARY

report to

THE COUNCIL ON ENVIRONMENTAL QUALITY

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
Springfield, Va. 22151

ECONOMIC IMPACT OF ANTICIPATED PAPER INDUSTRY POLLUTION – ABATEMENT COSTS

PART I: EXECUTIVE SUMMARY

Report to

The Council on Environmental Quality

November 1971

C-73977

Arthur D Little, Inc.

TABLE OF CONTENTS

	Page
List of Tables	iii
I. INTRODUCTION	1
II. FINDINGS AND CONCLUSIONS	3
A. INDUSTRY STRUCTURE	3
B. PROFITABILITY TREND	3
C. PRICE IMPACT	7
D. MILL SHUTDOWN PROBABILITIES	7
E. EMPLOYMENT IMPACT	10
F. INDIRECT IMPACTS	11
III. SUMMARY OF POLLUTION ABATEMENT COST ESTIMATES	14

LIST OF TABLES

Table No.		Page
1	Summary of Economically Marginal Pulp and Paper Capacity, 1971	4
2	Paper Industry Financial Summary, 1970	5
3	Summary of U.S. Paper Industry Operating Rate Trends, 1970-1973	6
4	Anticipated Pollution Abatement Cost Impact on Prices, 1972-1976	8
5	Summary of Mill Shutdown Probabilities, 1972-1976	9
6	Summary of Employment Impact by Region	11
7	Summary of Anticipated Pollution Abatement Costs	15

I. INTRODUCTION

This analysis provides our assessment of the economic impact on the paper and related industries that will result from the air and water pollution control requirements anticipated through 1976. Developed within a period of nine weeks under contract with the Council on Environmental Quality, the analysis is meant to provide information that can be used in formulating federal policy for pollution abatement programs in the paper industry over the next five years.*

The information contained in this analysis is based upon our knowledge of and experience with the paper industry plus data derived from a number of sources during the analysis. Of substantial assistance were the supply/demand data and analyses of industry financial performance compiled by the American Paper Institute (API). Our analyses of economically marginal mills were based on our familiarity with many mills and on the mill data file that we have derived from the two industry directories: *Lockwood's* and *Post's*. We cross checked our identification of marginal mills with the API Divisions for tissue paper, printing and writing papers, and paperboard, and with key officers of firms judged to be marginal within these sectors and within the special industrial paper, insulating board, construction paper, and semi-chemical corrugating-medium product sectors.

Each of the above sectors was found to contain a relatively large number of marginal mills and to have experienced severe financial difficulties in 1970 and, except for construction paper, in 1971. Through our company contacts we obtained data from a number of mills that would serve to characterize the financial performance of typical marginal mills in each sector. We are indebted to the companies that provided us with the information; to safeguard their interests we have pledged to maintain the strictest confidence on individual company data.

The basic approach used in our analysis was to subdivide the industry into its major product sectors. We then assessed which mills in each sector are marginally profitable in today's market. Our assessment was based primarily on paper machine and mill size criteria, but also took into account the relative severity of pollution control problems in each sector, current overcapacity and price weakness, the degree of vertical integration of the facility and current industry profitability levels. Then we evaluated future supply/demand trends in each sector to determine the likelihood that future price increases can be obtained to restore profits to an adequate level and to absorb additional pollution abatement costs. (This analysis is described in Part II.)

---

*The term "paper industry" as used throughout this report includes all of its components: pulp, paper, paperboard, and building paper and board. In most cases we exclude converting operations unless they are an integral part of the paper mill.

We then evaluated (see Part III) the estimated pollution abatement costs against current prices of pulp and paper products and expected profitability of marginal firms to assess the impact of these costs on price increases and mill shutdowns. The mill dislocations were compared with our estimates of mill closures that would occur without any pollution abatement expenditures above current levels. The estimates of productive capacity removed were then utilized to reflect the number of jobs that would be lost in each major region of the country because of the impact of pollution control requirements. Finally, we called upon our specialists in supplier industries to determine the impact upon them.

The underlying economic assumptions used in this analysis were:

(1) real growth in gross national product will average 4%/year between 1971 and 1976 with somewhat higher growth (5%/year) in 1972 and 1973; and

(2) paper prices will be determined solely by market conditions rather than by regulated price controls.

The assumptions regarding degree of pollution abatement required by 1976 were:

(1) Water: entire paper industry will be required to remove 95% of the suspended solids in its waste water through primary treatment systems, and reduce biological oxygen demand (BOD) by 90% through secondary systems.

(2) Air: entire industry will meet the air pollution abatement regulations, tentatively adopted by Oregon; namely, that maximum discharge of particulate matter will be less than four pounds per air dried, unbleached ton of kraft pulp (or 90% particulate removal in other processes) and that the maximum discharge of reduced sulfur gases will be less than 10 parts per million (dry basis) in the tail gas.

Note that both the capital and operating costs and their impacts will rise extremely rapidly as the degree of pollution abatement approaches zero pollution.

II. FINDINGS AND CONCLUSIONS

A. INDUSTRY STRUCTURE

About 45% of all U.S. mills – accounting for some 15% of total U.S. paper capacity, are economically marginal by current standards of efficiency.* In general, this means that they fall below the current minimum economic size for mills in their product sector. These mills will have the greatest difficulty in meeting the anticipated pollution abatement requirements. Table 1 shows the distribution of these mills by product sector.

B. PROFITABILITY TREND

The paper industry's profitability is at its lowest point since World War II, with after-tax returns on total assets averaging about 4% in 1970. Profitability has declined further to about 3% of total assets in 1971, judging from the financial performance reported by 39 publicly held companies for the first nine months of 1971.

Table 2 provides various measures of the total industry's financial performance in 1970, and a comparison of the profitability of typical marginal mills in key impact product sectors. It indicates that profitability for the industry as a whole is clearly below that necessary to attract capital over the long term. The situation for economically marginal mills is considerably worse. Thus, this industry's ability to finance the capital costs and absorb the additional operating costs necessary for pollution abatement will depend upon its ability to improve profits through price and productivity improvements.

Table 3 summarizes our projections of U.S. paper industry operating rate trends between 1970 and 1973.** Our analysis points to improved operating rates in most sectors of the industry by 1973, assuming real GNP growth of 5% in 1972 and 1973. Significant overcapacity is expected to continue through 1973 in three product sectors: insulation board, semi-chemical corrugating medium, and special industrial paper. Mills in these sectors will have great difficulty in coping with additional pollution abatement costs because of weak prices and low profits. For the rest of the industry the market environment will generally provide increased mill utilization and be conducive to price increases in the absence of rigid price

* In this report, except as noted, the term "mill" refers to a single facility that includes both pulp and papermaking facilities; that is, an integrated facility is considered a single mill.

** 1973 was chosen as the terminal year since this is as far ahead as one can accurately predict capacity expansion.

TABLE 1

SUMMARY OF ECONOMICALLY MARGINAL PULP AND PAPER CAPACITY, 1971

Production Sector	Total No. of Mills	Economically Marginal Mills			
		Size Criteria (under tons/day)	No. of Mills	Percent of Total Mills	Percent of Total Capacity
Sulfite Pulp	37*	150**	12	33*	14
Semi-Chemical Pulp	41*	200**	9	22*	6
Tissue	102	50	49	48	18
Printing, Writing and Related	138	200	97	70	48
Special Industrial Paper	38	25	9	25	17
Combination Paperboard	170	100	78	49	27
Other Packaging Paper and Board	97	200–400	17	18	5
Newsprint and Groundwood	32	350	11	29	19
Construction Paper	47	100	31	60	36
Insulation Board	23	100	6	26	9
Hardboard	29	100	10	35	10
Total	752		329	44	15

*Nearly all of these pulp mills are integrated to mills making paper and paperboard.

**Includes some larger mills without chemical recovery systems.

Source: Arthur D. Little, Inc., estimates

Arthur D Little Inc

TABLE 2

PAPER INDUSTRY FINANCIAL SUMMARY, 1970

	Total Industry	Typically Economically Marginal Mills			
		Tissue	Printing and Related	Special Industrial	Combination Board
Percent of Sales					
Profit before Tax	6.6	(7.7)	1.5	4.8	3.0
Profit after Tax	4.1	(2.3)	0.9	2.4	1.5
Depreciation and Depletion	4.8	4.6	4.4	2.0	3.3
Cash Flow	8.9	2.3	5.3	4.4	4.8
Percent of Total Assets				*	*
Profit before Tax	6.4	(13)	1.8	8.0	2.0
Profit after Tax	4.0	(4)	1.1	4.0	1.0
Depreciation	4.7	8	5.0	3.3	2.2
Cash Flow	8.7	4	6.1	7.3	3.2
Depreciated Asset Value	55	75	55	53	27

*In these large composites we used gross fixed assets as an approximation of total assets, since the mills were parts of larger companies.

Sources: American Paper Institute composites (Total Industry and Non-Integrated Printing and Related). Arthur D. Little, Inc., composites (Economically Marginal Tissue, Special Industrial and Combination Board).

Arthur D Little Inc

TABLE 3

SUMMARY OF U.S. PAPER INDUSTRY OPERATING RATE TRENDS 1970–1973

Product Sectors	Operating Rate, Percent of Year-End Capacity 1970	1973 (Estimated)
Pulp		
Dissolving	97	99
Bleached Kraft (integrated and market)	93	97
Packaging		
Unbleached Kraft Board	92	96
Semi-chemical Board	89	87
Combination Board	86	94
Bleached Paperboard	100	100
Unbleached Kraft Paper	91	97
Bleached Paper	94	99
Communication Paper		
News and Uncoated Groundwood	96	98
Coated Paper	91	97
Uncoated Book, Writing, and Related	87	95
Bleached Bristols	91	98
Building Paper and Board		
Construction Paper	73	89
Hardboard	95	97
Insulation Board	70	77
Others		
Tissue and Other Creped	86	93
Special Industrial Paper	74	81
Wet Machine Board	95	92

Sources: Arthur D. Little, Inc., estimates of 1973 demand. American Paper Institute survey of capacity expansion plans.

controls. Between 1974 and 1976 we expect operating rates to decline again judging from previous cycles in this industry. Industry profitability will follow the same cyclical trend.

C. PRICE IMPACT

To determine the price increases necessary to absorb the increased pollution abatement costs anticipated by 1976, we compared the abatement costs for efficient mills with the approximate median price of each product group (Table 4). The major price increases relative to current prices will be in hardboard, newsprint and uncoated groundwood, bleached kraft pulp and unbleached kraft linerboard. Here, the price increases range from 6.5 to 10% of product value, depending upon the grade. Product sectors that will experience moderate price increases (3.5 to 6% of current product value) are: bleached paperboard, semi-chemical corrugating medium, bag and wrapping paper, combination paperboard, insulation board, printing papers, and dissolving pulp. The other product sector will require only modest price increases.

We anticipate that all of the above price increases will be obtained (in the absence of price controls) because of the tightening supply/demand balances projected for most sectors in 1972 and 1973. In many sectors increases significantly higher than those reflected in Table 4 are anticipated by 1974. Beyond 1974 prices might well decline again should the industry enter another cycle of overcapacity.

In most cases abatement cost levels for marginal mills will be appreciably higher than those for larger more efficient mills since the latter benefit from economies of scale. This factor adds to the economic difficulties of the marginal mills.

D. MILL SHUTDOWN PROBABILITIES

Table 5 summarizes mill shutdown probabilities between 1972 and 1976 with and without pollution abatement expenditures above current levels. It indicates that the key impact areas are: sulfite and semi-chemical pulp, tissue paper, printing and writing paper, special industrial paper, and combination paperboard. In addition to these we expect less extensive dislocations to occur in other product groups – mainly newsprint, uncoated groundwood paper, and packaging paper and board.

Some mills in all of the above sectors will close by 1976 strictly because of economic considerations, but the closure rate will be increased significantly by the requirement to expend capital to correct a pollution problem. In most cases marginal single-mill companies in these sectors will be unable to obtain capital for

TABLE 4

ANTICIPATED POLLUTION ABATEMENT COST IMPACT ON PRICES
1972-1976

Key Grades	Approximate Current Average Price ($/ton)	Estimated Abatement Cost for Efficient Mills ($/ton)	% Increase Over Current Price
Unbleached Kraft Liner	120	8.50	7
Bleached Paperboard	210	12.00	6
Semi-chemical Medium	104	5.50	5.5
Combination Paperboard	110	5.50	5
Unbleached Bag and Wrapping	160	8.50	5.5
Bleached Packaging Paper	200	11.00	5.5
Newsprint	160	12.50	8.5
Uncoated Groundwood	180	12.50	7
Coated Publication	220	8.50	4
Uncoated Book	220	8.50	4
Tissue Paper (Converted)	400	8.50	2
Special Industrial Paper	600	9.50	1.5
Construction Paper (shingles)	65	1.00	1.5
Insulation Board	135	6.00	4.5
Hardboard	80	7.50	10
Bleached Kraft Pulp			
Hardwood	120	10.00	8.5
Softwood	140	10.00	7
Dissolving Pulp	220	7.05	3.5

Source: Arthur D. Little, Inc., estimates

TABLE 5

SUMMARY OF MILL SHUTDOWN PROBABILITIES, 1972-1976

Product Sector	Marginal Capacity (000 tons/yr)	Probability of Closure		Capacity Removal	
		Status Quo* (%)	Additional Abatement (%)	Status Quo* (000 tons)	Additional Abatement (000 tons)
Sulfite and Semi-Chemical Pulp	750	5-10	65	50	485
Tissue	650	15	50	105	345
Printing, Writing and Related	4,730	10	20	490	890
Special Industrial Paper	60	30	85	20	50
Combination Paperboard	2,030	10	25	200	540
Other Products	3,315	5	25	205	775
Total	11,535			1,070	3,085

*Assumes no additional pollution control expenditures above current levels.

Source: Arthur D. Little, Inc., estimates

pollution control equipment because their return on investment is destined to remain very low. Most such mills are not integrated to woodpulp and will face a cost/price squeeze since prices for the market pulp or waste paper upon which they are dependent are expected to increase at a more rapid rate than the price of the end products which they produce. The life of many of these mills will be prolonged if they are able to minimize their capital costs by joining in a municipal water treatment system. For other mills, particularly tissue paper and special industrial paper companies, it is still questionable whether they can absorb the increased operating costs for pollution abatement since these costs are significantly higher for them than for large-scale producers.

Many marginal mills are parts of larger companies which will have difficulty justifying the expenditure of the necessary capital in an obsolete facility. A number of tissue, printing and writing, and combination paperboard mills fit this category. In many cases the parent companies will elect to centralize their production in a larger mill rather than revamp a marginal mill. Again the life of these mills will be extended if they are able to share a municipal treatment system and thus minimize the required capital investment.

We expect all six of the marginal mills in the insulation board sector to be closed by 1976 strictly because of the economic pressures resulting from stagnant demand and continuing overcapacity. Pollution control requirements will advance their shutdown by about three years.

Product sectors where we expect no shutdowns as a result of the increased pollution abatement costs through 1976 are: unbleached kraft linerboard, bleached paperboard, construction paper, hardboard and bleached kraft pulp. In each of these sectors we anticipate significantly improved operating rates through 1973 which will restore profitability to an acceptable level and create an environment for price increases to fully absorb the increased operating costs for pollution abatement anticipated through 1976. By 1974 firms in these sectors should have made commitments for the capital expenditures necessary to meet the 1976 abatement requirements.

E. EMPLOYMENT IMPACT

Table 6 translates our tonnage removals due to pollution abatement in each product sector into a regional employment impact. We expect about 16,000 jobs in the paper industry to be lost by 1976 because of mill shutdowns caused by the anticipated pollution abatement requirements. In addition to the direct employment losses there will be indirect losses of jobs in the local service and supplier industries. These generally will amount to about 200% of the direct labor impact and will raise the unemployment totals accordingly. The greatest impact will be felt in the New England, Middle Atlantic, and North Central regions which together will incur about 85% of the paper industry unemployment. The remaining 15% of the jobs will be split between the West and the South.

Within some of these regions the unemployment impact will be localized and severe. Principal examples are small communities in Massachusetts, Connecticut and the northern portions of New York and Wisconsin. Most of these communities are highly dependent on the local paper industry and are in areas already considered "depressed" by the Economic Development Administration. Thus there are relatively few nearby employment alternitives for the affected workers.

Production capacity lost through marginal mill closures will be made up by mill construction or expansions principally in the South and West and to a lesser extent in Maine and Minnesota. Such expansion should more than compensate for pollution related jobs lost in the South and the West; however, they will do little to relieve the unemployment in other regions. These expansions not only will involve long distance moves by the unemployed mill workers in the other regions, but also, because of economies of scale, will offer fewer jobs than those eliminated by the closures.

TABLE 6

SUMMARY OF EMPLOYMENT IMPACT BY REGION

Region	Net Capacity Removed Due to Additional Abatement (000 tons)	Jobs Lost in Paper Industry	Jobs Lost in Service and Support Industries
New England	645	6,000	12,000
Mid-Atlantic	350	4,400	8,000
North Central	560	3,150	6,300
South Atlantic	45	750	1,500
South Central	110	300	600
West	305	1,550	3,100
Total	2,015	16,150	32,300

Source: Arthur D. Little, Inc., estimates

F. INDIRECT IMPACTS

1. Supplier Industries

In the logging industry we expect pollution-related job reductions of about 200 workers in New England, 700 in the North Central region, 400 in the West, and 70 in the South Central region. We believe that indirect unemployment in these relatively remote logging areas will be about 50% of these figures.

In New England and in the North Central region the reduction in pulpwood demand will have a more significant impact than the above numbers indicate. Much of this timber is supplied by small woodlot owners who harvest their wood on a part-time basis to obtain supplementary income. Thus, many part-time jobs are at stake.

In the West the decline in jobs will probably be offset by increased activity in the export of wood chips. Woods labor in this region is involved primarily in sawlog production since the pulp mills use mostly saw mill residue rather than roundwood. In the South the job loss is small and will be offset by growing demand for pulp wood and sawlog production.

We anticipate significantly reduced saltcake consumption in the U.S. kraft pulping industry as a result of greater recovery of sulfur values to minimize the air pollution caused by the process. We estimate that this factor, coupled with substitution of other chemicals to provide sodium values, will lead to a consumption loss of 750,000 tons, mostly from imported and natural saltcake. We estimate a loss of employment of about 500 jobs, primarily from domestic natural saltcake production in the West.

We also estimate a displacement of chlorine consumption by the paper industry as chlorine bleaching processes are increasingly replaced by oxygen bleaching to avoid water pollution. Oxygen bleaching should reduce chlorine consumption about 140,000 tons by 1976. This reduction will result in the loss of roughly 70 jobs in the chlor-alkali industry, mainly in the Southeast and Northwest.

The implementation of increased water and air pollution abatement by the paper industry in itself will create new increments of market demand for capital goods industries associated with the abatement processes. The effects will be substantial in the initial years as existing manufacturing plants expend capital to meet evolving pollution abatement requirements. We expect the paper industry's capital expenditures (in 1971 dollars) to amount to $2.5 billion for water pollution between 1972 and 1976, and $800 million for air pollution, for a total of $3.3 billion if the assumptions about abatement levels and timetables are correct.

2. Customers

Our analysis shows increased pollution expenditures to have no measurable impact upon market demand trends since demand for paper products is generally price inelastic. Accordingly, we do not foresee significant changes in growth rates associated with the use of the various paper and board products comprising this industry. In every case where we anticipate capacity removals as a result of additional pollution abatement costs, the larger and more efficient producers should be able to make up for the tonnage lost. Therefore, customers generally should have no difficulty in obtaining pulp and paper products as a result of this capacity removal.

As noted earlier, price increases ranging from 2 to 10% of product value can be expected as a result of the additional pollution abatement costs anticipated through 1976. However, the paper industry's profitability is extremely low and price increases are already needed if profits are to be restored to a level that will attract sufficient capital to expand capacity and assure a continued supply of these products beyond 1973 when supply and demand are expected to be closely balanced. Thus, if the market behaves freely, customers of the pulp and paper industry can expect more significant price increases from market and general economic factors than from pollution abatement costs. If a stringent price control is levied on the industry there is likely to be a shortage of paper products after 1973.

3. Balance of Payments

The pollution abatement costs anticipated through 1976 will not significantly affect the international competitiveness of U.S. paper producers. The pollution abatement objectives are similar in all of the pulp and paper producing regions of the world. Also, differences in implementation schedules are expected to be small (probably less than three years), and not sufficient to cause a substantial shift in world trade patterns and capital flow for pulp and paper production. Consequently, pollution abatement in the paper industry should not exert a measurable impact upon the United States balance of payments with respect to Canada, Scandanavia, Western Europe, or other competing regions of the world.

III. SUMMARY OF POLLUTION ABATEMENT COST ESTIMATES

We called upon our own specialists in water and air pollution control to analyze the capital and operating costs associated with the pollution abatement requirements anticipated over the next five years. They drew upon a variety of sources of current cost data including both published and unpublished Environmental Protection Agency (EPA) data; the Department of Commerce report, "Control of Atmospheric Emissions in the Wood Pulping Industry" by E.R. Hendrickson, et al.; information and reports provided by the National Council of the Paper Industry for Air and Stream Improvement; and our own data on costs incurred by specific mills. These data were then applied to the air and water emissions associated with each major type of pulp and paper making process to calculate the anticipated capital and operating costs for each.

We found that our cost estimates for water pollution abatement generally fell close to the median of those provided by EPA for this study; we felt, however, that the EPA data were not specific enough for our detailed product sector analysis and that a narrower range of uncertainty (typically ± 20%) could be placed around our estimates. Our air pollution costs are higher than those provided by the EPA since the latter did not take into account removal of reduced sulfur gases except in defining the upper range of uncertainty in the EPA data. However, our costs for sulfur compound removal should be considered tentative since the technology is not yet fully defined. Table 7 shows the basic cost estimates we employed. (The bases for these estimates are discussed in Part III.)

TABLE 7

SUMMARY OF ANTICIPATED POLLUTION ABATEMENT COSTS[1]

Product Sector	Operating Costs ($/Ton)			Capital Costs ($000/Daily Capacity Ton)		
	Water[2]	Air	Total	Water[2]	AirAir	Total
News and Uncoated Groundwood	13.20	1.00	14.20	23	3	26
Printing and Writing[3]	10.50	1.00	11.50	16	1	17
Tissue[3]	12.20	1.00	13.20	18	1	19
Unbleached Industrial and Converting	8.30	2.50	10.80	20	1	21
Unbleached Kraft Board	6.50	2.50	9.00	13	3	16
Semi-Chemical Medium						
With Cross Recovery	3.80	2.00	5.80	13	2	15
Without Recovery	11.50	2.00	13.50	20	2	22
Bleached Packaging and Board	9.70	2.50	12.20	22	3	25
Combination Board[3]	6.20	1.00	7.20	10	1	11
Construction Paper[3]	5.90	1.00	6.90	9	1	10
Insulation Board[3]	7.10	1.00	8.10	9	1	10
Hardboard[3]	8.70	1.00	9.70	8	1	9
Bleached Kraft Pulp	7.70	2.50	10.20	16	2	18
Bleached Sulfite Pulp	8-17	2.00	10-19	8-43	2	10-45
Groundwood Pulp	2.90	1.00	3.90	4	–	4
Deinked Waste Paper –	13.80	1.00	14.80	20	–	20

1. Based on minimum economic size mills in 1971 dollars. Costs for economically marginal mills are higher. Example: operating costs/ton – Tissue $19; Printing and Writing $19; Special Industrial $26; Combination Board $9. Capital costs/daily ton ($000): Tissue $46; Printing and Writing $43; Special Industrial $52; Combination Board $17.
2. Based on extended aeration.
3. Not integrated to pulping.

Source: Arthur D. Little, Inc., estimates